

## TU81-Plus

### The Price/Performance Leader for Midrange Systems

digital



#### **Cache-Enhanced Performance, High Reliability and GCR Density Make the TU81-Plus Ideal for Midrange Applications.**

The TU81-Plus offers significant advantages to users of non-clustered systems. On most systems, disk backup (and other applications) will take much less time because the drive's built-in cache buffer provides greatly enhanced performance, as compared to the cacheless original TU81. Yet our unique cache design avoids the data integrity risks inherent in traditional designs. In addition, the TU81-Plus brings these benefits to a wider range of systems than ever before. It is the first tape drive that connects directly to the VAXBI bus and it is our first high density drive for MicroVAX II systems. It also connects to UNIBUS VAX and PDP-11 systems.

Investment protection is another major benefit. Upgrade kits allow TU81 tape subsystems to be converted to enhanced-performance TU81-Plus units, and either subsystem can be converted to a TA81 (HSC-based) drive when you decide to step up to a VAXcluster system.

In short, the TU81-Plus is Digital's price/performance/value leader for midrange systems with high-capacity disks.

With its streaming tape technology, the TU81-Plus is ideal for applications involving sustained tape input/output such as disk backup, data archiving, or recording data from high-speed test equipment. Yet it also uses traditional start/stop technology for shorter data transfers of the type associated with journaling, transaction processing, and classical data processing. The streaming design contributes to the drive's ease of use, compactness and exceptionally quiet operation, which makes the TU81-Plus a welcome companion in any computer installation.

### Highlights

- Significantly faster operation than the original TU81 for disk backup and other common applications, because the drive's 256-Kbyte cache buffer optimizes performance, helping the drive achieve its top speed of 75 inches per second more often. Automatic speed control and pre-fetching of commands and data further enhance performance.
  - Provides higher data integrity than traditional cache designs, because the TU81-Plus cache can be turned off for applications in which data could be at risk. The TU81-Plus also provides read-after-write verification and automatic two-track error detection and correction (in GCR mode) during operation.
  - Supported on a wide range of systems: VAXBI and UNIBUS-based VAX systems, MicroVAX II and UNIBUS PDP-11 systems.
  - Protects your investment; upgrading a TU81 to a TU81-Plus, or either drive to a TA81 can be done at your site in just a few hours.
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- Ideal for data interchange because it provides industry-standard recording at 6250 bits per inch (GCR) and 1600 bits per inch (PE). High-density GCR recording provides 145-Mbyte capacity on a standard 2400-foot reel, thereby reducing media costs and time-consuming reel changes.
  - Provides considerably higher performance and data integrity, while requiring fewer reels of tape and less operator attention than the TU80.
  - Offers exceptional reliability and low cost of ownership, thanks to its simplified streaming design.
  - Designed for ease of use with no required adjustments and no preventive maintenance except for normal head cleaning.
  - Designed for serviceability with an extensive set of fault-isolating diagnostics and easy access to all field-replaceable units from the front of the cabinet.
  - Human-engineered for the office or computer room environment—quiet, easy to operate, and attractively packaged with space for an RA-series Winchester disk drive in the bottom of the cabinet.
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### Dramatically Enhanced Performance

#### *Cache Enhancement*

A built-in 256-Kbyte cache buffer significantly improves the streaming performance of the TU81-Plus, as compared to uncached streaming tape drives (such as the original TU81). When the buffer is in operation, data moves from the CPU to the cache before being written to tape (vice versa for read operations). This two-step transfer frees the tape drive from a rigid dependence on the (frequently slower) host processor transfer rate, and allows the tape drive to optimize its operation. As a result, the TU81-Plus operates more frequently at its peak 75 ips (inches per second) streaming speed, and less frequently needs to stop and reposition (see explanation below) while waiting for data from the CPU.

The Digital Storage Architecture (DSA) further enhances the drive's performance. Using the DSA software protocol, the TU81-Plus controller will prefetch the next commands (as well as data) while the tape drive is completing previous data transfers. These commands are also stored in the cache, allowing the tape drive to move immediately from one operation to the next without waiting for new instructions to arrive from the host processor. This capability further maximizes the likelihood of high-speed streaming operation.



### Automatic Speed Control

The TU81-Plus features an adaptive speed control that automatically selects the speed most appropriate to the CPU data input/output rate. For example, with sustained high data rates, the TU81-Plus automatically streams at 75 ips. The cache buffer maximizes this high-speed operation. If, however, the CPU data rate consistently falls below the rate needed to maintain the 75 ips, the drive's microprocessor-based controller automatically changes the speed to 25 ips streaming. Conversely, if the TU81-Plus has been successfully streaming at 25 ips for a predetermined time period, the adaptive speed control raises the speed to 75 ips.

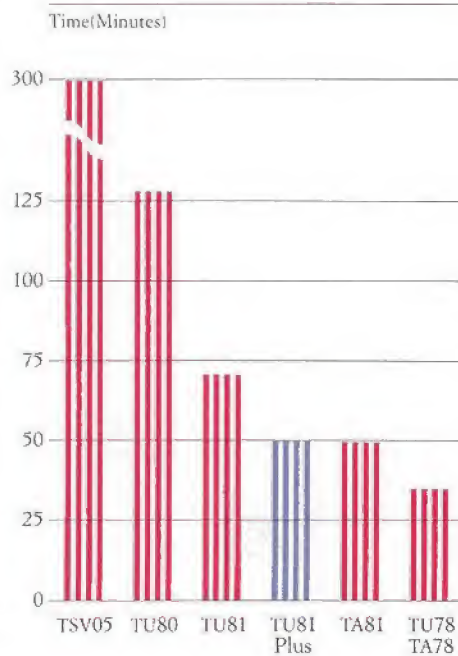
A similar algorithm controls changes between 25 ips streaming and 25 ips start/stop operation. This ability to revert to more conventional start/stop technology is extremely important because pure streaming tape drives cannot stop and restart within the interblock gap defined by the ANSI-standard recording formats. These drives must first slow to a stop, back up over a section of previously processed tape, await the next command, and then accelerate to operational speed by the time they reach the interblock gap. In order to prevent excessive time being spent on this repositioning, the adaptive speed control automatically changes the TU81-Plus to the 25 ips start/stop mode when the CPU cannot maintain a streaming data rate. This capability is most useful in applications involving very slow or intermittent data transfers, where the cache buffer offers little help.

### The Bottom Line

The performance of the TU81-Plus on any particular system will depend on the data transfer rate provided by the host system. This rate is affected by the type of CPU, the load on the system, the speed of the disk drives, and the efficiency of the application software that is sending data to the tape subsystem. When running VMS Backup, with the tape drive in GCR mode (6250 bpi), several software switches can be used to optimize performance without compromising data integrity. These switch settings can provide up to 100 percent performance improvement over the default settings and are noted in the accompanying performance graph.

The graph is a guide to relative performance. It demonstrates that, on average, the performance of the TU81-Plus is approximately two-and-a-half times as fast as the TU80, one-third faster than the TU81, and about two-thirds as fast as the TU78. Clearly, the TU81-Plus is the price/performance leader for midrange systems. On MicroVAX II systems, the TU81-Plus provides three to five times the performance of the TSV05 or TK50, making the TU81-Plus the clear choice for time-critical applications.

### Relative backup performance of clustered and local tape subsystems



*This data represents RA81 backup (456 Mbytes) on a range of VAX systems, using VMS Backup (with VMS switches used to optimize performance; Buffer = 5/NOCRC/Block size = 16 Kbytes). \* TU81s were paired with UDA50-based disks, and TA drives were paired with HSC50-based disks. One tape drive was used. Using two drives can eliminate tape rewind and handling times, which are included in the chart times. Performance on your system may vary based on several parameters, but you can use this data as a guideline to relative performance.*

*\*The PE-only TU80 and TSV05 were run with CRC on, and Block size = 8 Kbytes, as recommended for non-GCR operation. PE drives do not provide tape drive CRC, and therefore CPU CRC must be run to safeguard data integrity. CRC does impact performance. TSV05 was run on MicroVAX II.*



*The TU81-Plus is Digital's entry-level Group Coded Recording (GCR) drive, offering the lowest cost of ownership and highest reliability of any Digital-supported GCR tape drive.*

### **Outstanding Data Integrity**

In addition to the high data integrity inherent in the GCR format, the TU81-Plus provides an extra level of protection because of the unique design of its cache.

The buffer in the TU81-Plus is software selectable; that is, you can turn the cache on or decide not to use it, depending on your application. This flexibility and control is important, because for applications such as backup, the cache provides a significant performance gain; but in other applications such as data logging or transaction processing, a cache can create a risk of data loss. In these applications, data is deleted in the CPU after it is written to tape. If a tape cache is involved, this information is deleted after it is written to the cache and before it is recorded on tape. Any error in the data transfer from cache to physical tape (e.g., a power failure) would be unrecoverable. When you run such applications, you will want to leave the cache off. Only the TU81-Plus offers this choice to the programmer.

In any application, the TU81-Plus ensures data integrity by recording Error Correction Code (ECC) and Cyclic Redundancy Check (CRC) characters on the tape in GCR mode

and recording parity bits in PE mode. Algorithms use these extra bits to make single-track error correction at 1600 bpi, and double-track correction at 6250 bpi, without the requirement for retries. In PE mode, the operating system supplies the additional data integrity protection, but at significant cost to performance.

The TU81-Plus also performs a read-after-write check to ensure that each bit written is verified immediately after it has been recorded. Vertical parity is checked, character by character, at both densities when reading and writing.

In the rare event of an unrecoverable error, the TU81-Plus controller alerts the CPU immediately. Data reliability tests, available on VAX and PDP-11 processors, can then be used to ascertain the error rates and to help identify the problem.

### **Easy to Use**

The TU81-Plus has a simple 13-inch tape path for fast manual loading. This is the shortest path of any ANSI-compatible tape product in the industry.

Complementing the easy tape handling process is a conveniently located, clearly labeled membrane control panel with touch-sensitive switches. The TU81-Plus needs no adjustment or preventive maintenance except for routine, customer-performed head cleaning.



The TU81-Plus can be quickly installed on any supported system. The controller requires only one slot in the CPU backplane, and is compatible with the DSA software protocol.\*

#### **Reliable and Easy to Service**

The TU81-Plus shares the mechanical simplicity and proven reliability of the TU81. In the TU81-Plus, most of the mechanical components associated with conventional tape drives have been eliminated. Electronic elements have replaced vacuum columns, tension arms, roller guide bearings, mechanical tension/velocity transducers – and even the capstan.

The result is extraordinary reliability and user convenience. Digital's electronic controls are inherently more reliable than their traditional mechanical counterparts. The elimination of these mechanical elements also eliminates the need for adjustments and preventive maintenance.

Gentle tape handling further enhances reliability. The tape touches only the reels, the heads, and the tape cleaner. Even if a power failure during operation causes a short length of tape to unwind, the drive will take up tension slowly and gently before accelerating to speed.



*\*Consult your sales representative to be sure you have an operating system release that will support the TU81-Plus. At press time, support is provided by VMS V. 3.7 (and up), ULTRIX-32 V. 1.2, ULTRIX-11, RSX-11M V. 5.3 update C, RSX-11M-PLUS V. 3.0 update C, RSTS-E V. 9.1, and IAS. PDP-11 operating systems, except for ULTRIX, do not support cache operation.*

To reinforce user confidence, self-test diagnostics automatically check the drive and controller for proper functioning each time the TU81-Plus is powered on and during rewind. Any detected problem can be corrected before the drive is needed. User diagnostics that exercise the TU81-Plus and check the overall operation are easily initiated through dedicated front-panel diagnostic switches. Should errors be found, LED indicators display error codes that in many cases define operator-correctable conditions.

If a malfunction occurs, the TU81-Plus has extensive diagnostics to isolate and identify the failure quickly. Resident microdiagnostics, accessible from the front panel, help a field service engineer isolate an error. The drive also has an ASCII port that lets the engineer attach any RS232 terminal to run more detailed diagnostics interactively. In addition, host diagnostics on VAX and PDP-11 systems are available to thoroughly test the entire TU81-Plus subsystem. Any component that needs replacement can easily be reached from the front of the cabinet. The result is fast and effective repair.

### **Low Cost of Ownership**

The TU81-Plus with its competitive pricing and the lowest maintenance cost of any of Digital's industry-standard high-density tape products, has a substantially reduced cost of ownership compared to other tape drives. The drive's low power consumption and heat dissipation also contribute to the drive's low operating cost.

Whatever your tape processing needs—disk backup, archiving, data interchange between systems, data acquisition, or journaling—the TU81-Plus' high technology and simple but elegant engineering make it a reliable performer that is easy to use and inexpensive to own.

### **Investment Protection and High System Throughput—The Digital Storage Architecture**

The TU81-Plus is the newest member of Digital's unique DSA family of compatible mass storage peripherals. This architectural approach to mass storage design has important benefits for our customers—in terms of enhanced performance, increased system throughput and long-term investment protection.

As described in the *Performance* section, the DSA software protocol (Tape Mass Storage Control Protocol or TMSCP) allows the tape controller to prefetch commands and data, which significantly enhances the drive's performance in many tape applications. In addition, because DSA moves much of the I/O overhead from the CPU to the drive and controller, it leaves the CPU free to perform other application tasks. This helps increase overall system throughput.

Investment protection also appears in several ways. Your software investment is protected because DSA is supported on a wide range of Digital's CPUs and operating systems, and under DSA, all tape drives use the same protocols. This means that the TU81-Plus is compatible with existing application software, and that new applications designed to work with the cache buffer will also work with older, cacheless TU81s. It also means that no program changes are needed as you upgrade from one DSA storage device to another over time within any DSA-supported operating system environment. It even means that an application can be migrated from a MicroVAX II system with a TK50 all the way to a large VAX system with a TU81-Plus, and even to a VAXcluster with TA81 or TA78 drives, with no recoding needed!

Your hardware investment is also protected because DSA hardware compatibility makes upgrade kits feasible. Users with original TU81 drives can upgrade them to TU81-Plus drives to gain performance benefits, and either subsystem can be converted to a TA81 when you decide to move from stand-alone CPUs to a VAXcluster. The kits contain everything needed to upgrade the subsystems and can be installed at your site in just a few hours.



### Related Products

The TU81-Plus is one of Digital's series of industry-standard tape subsystems for nonclustered systems. Related products include:

TU80— Our lowest-cost, industry-compatible tape drive for UNIBUS VAX and PDP-11 systems, 1600 bpi, ideal for small cost-sensitive configurations.

TU78— Our high-performance leader for MASSBUS VAX systems; 1600/6250 bpi; with full start/stop operation, it is suitable for the widest range of applications.

TSV05— Our entry-level, industry-compatible tape drive for Q-bus VAX and PDP-11 systems, 1600 bpi, compact, well suited for small systems with moderate performance needs.

For VAXcluster Systems, we also offer the TA81 and TA78 tape subsystems.

If you'd like to learn more about the TU81-Plus or other Digital products, call your nearest Digital sales office or ask your Digital sales representative.

### Specifications

<b>Performance</b>	(See Performance section in text.)
Cache Buffer Size	256 Kbytes
Read/Write Speeds	75 and 25 ips, streaming; 25 ips, start/stop
Max. Data Transfer Rate	468 Kbytes per second
Average Rewind Speed	192 ips
Rewind Time	2.5 min (2400-ft reel)
<b>Data Organization</b>	
Recording Method	Nine-track; GCR to ANSI-standard X3.54-1976 and PE to ANSI-standard X3.39-1973
Recording Density	6250 bpi, 1600 bpi
Capacity	Standard: 145 Mbytes (GCR), 40 Mbytes (PE) (8-Kbytes block size). Max: 167 Mbytes (GCR; 64 Kbyte block size)
Record Length	Variable up to 64 Kbytes
Recording Medium	0.5-in ANSI-standard magnetic tape
Reel Diameter	26.7 cm (10.5 in), 21.6 cm (8.5 in), 17.8 cm (7 in)
<b>Operating Environment</b>	
Temperature Range	15°-33°C (59°-90°F)
Relative Humidity	20%-80%
Max. Wet Bulb	25°C (77°F)
Max. Altitude	3000 m (10,000 ft)
Max. Acoustic Noise	51 dBA
<b>Power Requirements</b>	
Standards	UL listed, CSA certified, FCC Class A verified
Voltage	120 Vac at 60 Hz; 240 Vac at 50 Hz
Phase	Single
Power Consumption	300 W standby, 500 W max.
Max. Heat Dissipation	1024 Btu/h
Power Plug	60 Hz—NEMA 5-30; 50 Hz—Schuko/CEE 7-7
Cable Length	7.4 m (24 ft) for 20-ft intercabinet distance



### Specifications (continued)

#### Physical Dimensions

Height	105.7 cm (41.6 in)
Width	53.9 cm (21.3 in)
Depth	76.2 cm (30.0 in)
Weight	105.75 kg (235 lb)

#### Configuration Rules

Interface	VAXBI, UNIBUS or Q-bus (adapter module and cables included with subsystem), DSA software protocol		
Max. Drives per Controller	1		
	UNIBUS	Q-bus	VAXBI
Bus Loads (ac/dc)	5.1/1.5	2.3/1.0	—
Current Drawn (+5 V)	4A	3A	7A
Mounting Requirements	1 quad slot	1 dual slot	1 VAXBI slot

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